ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

FY95 LIMITED ENERGY STUDY
AREA B NITRIC ACID PRODUCTION FACILITIES

HOLSTON ARMY AMMUNITION PLANT
KINGSPORT, TENNESSEE

CONTRACT NO. DACA01-94-D-0007
DELIVERY ORDER NO. 004

Prepared For:

Mobile District
U.S. Army Corps of Engineers
Mobile, Alabama

19971016 216

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Executive Summary

Introduction

In June 1995, Affiliated Engineers SE, Inc. (AESE) was retained by the Mobile District U.S. Army Corps of Engineers to perform a Limited Energy Study for Holston Army Ammunition Plant, Kingsport, Tennessee.

The field survey of existing conditions was completed in July 1995. The results of this field survey were subsequently tabulated and used to generate single line process flow diagrams on Autocad. A subsequent one day field survey was conducted in August 1995.

This report summarizes the results obtained from field investigation and the analysis of various alternative Energy Conservation Opportunities (ECO's).

ECO's were analyzed for suitability for the Energy Conservation Investment Program (ECIP) using the government's software package called Life Cycle Cost in Design (LCCID).

Scope of Work

The Scope of Work developed by the U.S. Army Corps of Engineers gave the following tasks:

1. Perform a field survey to gather information on existing operating conditions and equipment at Holston Army Ammunition Plant, Area "B", Building 302 Nitric Acid Production Facilities.

2. Analyze the following ECO's:

   a. Since 300 psig steam is available, revise air compressor turbine drive to steam. There may be variations on this ECO, such as using 300 psig steam exclusively (which might require a different turbine) or using steam (at 300 psig or at a reduced pressure) in the existing turbine to assist the electric motor.

b. Use the product gas leaving the Air Preheater to generate steam. Depending on the pressure of the steam generated, the gas could be cooled to perhaps as low as 400°F. The steam thus generated could be used to drive (or assist in driving) the air compressor, or it could be used to vaporize ammonia, or for heating at the 302-B tank farm.

c. Identify and evaluate the possibility of water conservation at the cascade coolers and at other points in the process.

3. Suggest and analyze any additional ECO's representing savings potential as selected by A/E.

4. Provide recommendations for implementation of ECO's into projects by SIR priority.

5. Prepare a report to document the work performed, results, and recommendations.

6. Provide documentation in the form of Project Development Brochures (PDB's) and DD Form 1391.

Building 302-B houses the processing facilities examined for ECO's.

Descriptions of ECO's

ECO No. 1 - Central Plant steam at 300 psig and 525°F is applied to a new 1200 hp compressor drive condensing single stage, Curtis type turbine. Exhaust steam at approximately 2.0 inches mercury vacuum is condensed in a new steam surface condenser using river water for heat rejection. The steam condensate from the condenser is returned to the central plant through condenser hotwell pumps.

Using projected operation of 1152 hours per year (4 days per month, 24 hours per day, 12 months per year), an annual electrical energy savings of 681,000 kWh/yr (2,324.97 mil. b/yr) and annual electrical demand charge savings of $13,050 will be realized. However, 10,583 MMBtu/yr of increased steam energy from the existing steam plant will be required.

The life cycle cost analysis using the governments LCCID program indicates an increased owning and operating cost will result from this ECO. It does not qualify for energy conservation funding.

ECO No. 2 - A closed loop high temperature heat transfer fluid system is utilized to recover heat from product gas and convert the recovered heat to 100 psig saturated steam for use within the ammonia oxidation process (AOP) process, with excess steam delivered to existing distribution piping to offset steam produced at the central plant.

At projected operation of 1,152 hrs/yr, the calculated 3,446 MMBtu/yr steam savings, at the expense of 25,900 kWh/yr (885 MMBtu/yr) and associated increased demand charges, when used in the LCIDD program, produce total net discounted savings of $13,175 for an estimated $214,000 investment, and results in Savings to Investment Ratio (SIR) of 0.06. This ECO does not qualify for funding.

ECO No. 3 - Cooling water is presently used in the AOP process and then released to drain; this ECO provides reuse of the cooling water by returning it to a cooling tower where heat from the process will be rejected. The LCCID program results show $71,024 discounted savings for a probable investment of $43,708. The calculated SIR is 1.62.

ECO No. 4 - Uninsulated process vessels containing high temperature process fluid flows are to be insulated with jacketed calcium silicate pipe insulation. The $5,408 probable cost of insulation will save about 135,000 kWh/yr of electricity at 1,152 hr/yr operation. The LCCID results show $111,758 discounted savings and SIR = 20.67.

ECO No. 5 - As an adjunct to ECO No. 4, heat will be reclaimed from compressor drive turbines exhaust to produce 30 psig steam for use in ammonia vaporizers.

The probable investment cost of $35,513 will save 664 MMBtu/yr of steam energy and 135,000 kWh/yr electrical energy during 1,152 hr/yr of operation. With associated annual electrical demand cost savings of $2,585 per year, the LCCID program shows $147,972 net discounted savings and SIR of 4.17.

ECO No. 6 - It was proposed to use the pure water condensed out of the compressed air and/or steam condensate from the ammonia vaporizers to increase mass flow through the

turbine and increase horsepower output. Although in theory this concept is viable for gas turbine engines, it was found to be infeasible for the uncontrolled turbine inlet conditions encountered in the AOP process.

ECO No. 7A - Recovered saturated steam at ±60 psig is to be injected into the tailgas flow from the absorption column to increase mass flow through the tailgas heater and turbine which will in turn increase power output from the turbine and offset electrical energy consumed by the compressor motor. The recovery equipment will not require "cutting-in" to the highly corrosive product gas system. The incorporation of a heat exchange at this location, constructed of stainless steel, was determined not to be cost effective (see LCCID output for ECO 7).

The proposed modifications will save more than 200,000 kWh/yr of electrical energy and $3,835 per year in electrical demand charges. The modifications render the process more independent from exterior energy sources. LCCID program results show $157,657 net discounted savings and SIR of 1.54 on total investment of $102,545.

Present Energy Consumption

There are four AOP lines at Building 302, each rated to produce 50 tons per day of 61 percent dilute nitric acid. To accommodate the present day demand for nitric acid in manufacturing explosives, intermittent operation of the production lines is employed. Production runs during each month constitute an aggregate single-line operation duration of ±1152 hours per year.

During production, electrical energy and thermal energy (steam from the central plant) are consumed, and filtered water from the central water treatment facilities is used. Process operations at current production rates use this energy as follows:

Electricity -	457,053 kWh/yr 1,560 MMBtu/yr $15,990 per year
Steam @ - Ammonia Vaporizer	823 MMBtu/yr $3,208 per year
Cooling Water -	2.2 million gallons per year

Technically Feasible ECO's

The results of the life cycle analysis of technically feasible ECO's, prioritized by descending savings-to-investment ratio, are as follows:

Priority	ECO No.	SIR	Total Investment	Simple Payback
1	4	20.67	$ 5,408	0.74
2	5	4.17	35,513	3.64
3	3	1.62	43,708	9.00
4	7	1.54	102,545	9.97
5	2	0.06	214,388	150.00
6	1	-0.23	177,197	-42.03

Synergistic Considerations

ECO No. 1 may be incorporated simultaneously with ECO No. 2 and/or ECO No. 3. ECO No. 1 is incompatible with ECO No. 5 and No. 7 since energy recovery in ECO No. 5 and No. 7 is primarily obtained from gas turbine exhaust gases which, in ECO No. 1, are not available. Combining ECO No. 1 with ECO No. 4 would negate the benefits from ECO No. 4 alone, and would increase the required heat rejection quantity at the cascade cooler.

ECO No. 2 is additionally compatible with either or both ECO No. 3 and ECO No. 4. Similarly, it is incompatible with ECO No. 5 and No. 7 for the same reasons stated above.

ECO No. 3 can technically be incorporated with any combination of the other ECO's.

ECO No. 4 can technically be incorporated with any combination of the other ECO's, and is an integral part of ECO's 5 and 7.

Recommendations

Implementation of heat exchanger insulation should be completed immediately. The modest cost involved should be available from operation and maintenance funds. Both qualifying ECO's No. 5 and No. 7 include this insulation. Because ECO No. 7 provides greater independence from off-site utilities, it is recommended over ECO No. 5 which is economically more attractive.

Implementation of ECO No. 3 is also recommended, since it is economically attractive.

LIFE CYCLE COST ANALYSIS SUMMARY STUDY: 95094
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) LCCID 1.080
INSTALLATION & LOCATION: HOLSTON ARMY AREGION NOS. 4 CENSUS: 3
PROJECT NO. & TITLE: 95094 AREA B NITRIC ACID PRODUCTION FACILITY
FISCAL YEAR 1996 DISCRETE PORTION NAME: ECO #7 RECOVERED STM INJECT @ TLGS TURB
ANALYSIS DATE: 12-22-95 ECONOMIC LIFE 20 YEARS PREPARED BY: LITTLE

1. INVESTMENT

A. CONSTRUCTION COST	$ 93920.		
B. SIOH	$ 4125.		
C. DESIGN COST	$ 4500.		
D. TOTAL COST (1A+1B+1C)	$ 102545.		
E. SALVAGE VALUE OF EXISTING EQUIPMENT		$ 0.	
F. PUBLIC UTILITY COMPANY REBATE		$ 0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)			$ 102545.

2. ENERGY SAVINGS (+) / COST (-)
DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1993

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 10.25	670.	$ 6868.	15.61	$ 107202.
B. DIST	$ .00	0.	$ 0.	17.56	$ 0.
C. RESID	$ .00	0.	$ 0.	19.97	$ 0.
D. NAT G	$ .00	0.	$ 0.	20.96	$ 0.
E. COAL	$ .00	0.	$ 0.	17.58	$ 0.
F. LPG	$ .00	0.	$ 0.	16.12	$ 0.
M. DEMAND SAVINGS			$ 3835.	14.74	$ 56528.
N. TOTAL		670.	$ 10703.		$ 163730.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-)		$ -412.
(1) DISCOUNT FACTOR (TABLE A)	14.74	
(2) DISCOUNTED SAVING/COST (3A X 3A1)		$ -6073.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-)(4)
d. TOTAL	$ 0.			0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4)	$ -6073.
4. FIRST YEAR DOLLAR SAVINGS (2N3+3A+(3Bd1/(YRS ECONOMIC LIFE))	$ 10291.
5. SIMPLE PAYBACK PERIOD (1G/4)	9.97 YEARS
6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C)	$ 157657.
7. SAVINGS TO INVESTMENT RATIO SIR)=(6 / 1G)= (IF < 1 PROJECT DOES NOT QUALIFY)	1.54
8. ADJUSTED INTERNAL RATE OF RETURN (AIRR):	5.34 %